CLEAR, A multi-media package for Comfortable Low Energy Architecture

A. Jacobs, F. Nicol, M. Wilson and J. Solomon
Low Energy Architecture Research Unit (LEARN), London Metropolitan University, Spring House, London, United Kingdom

ABSTRACT

CLEAR [1] is a web-based interactive teaching package on low energy architecture and human comfort. It was developed by the Low Energy Architecture Research Unit, LEARN [2], of the London Metropolitan University with the collaboration of European and international academic partners. *CLEAR* is available on the Internet and may be used freely and without registration by everybody interested in the field. The development of *CLEAR* is based on the earlier *DayMedia* [3] and *MulCom* [4] packages, and is part-funded by the European Commission.

1. INTRODUCTION

The production of Carbon Dioxide (CO_2) from the burning of fossil fuels in the production of energy is now accepted as a major contribution to global warming and climate change. As a result the reduction of energy use is a global imperative. The building industry is responsible for up to 50% of all energy use, either in the construction and maintenance of buildings or in their use of heating or cooling. Whilst energy use in buildings is generally lower in countries with developing economies such as India, there is nevertheless an enormous potential for energy use for cooling and heating in the future.

Much of this potential energy use could be circumvented by ensuring that buildings work with the climate rather than against it. This approach - called climatic or bioclimatic design - uses the properties of the building itself and the natural behaviour of its occupants to ensure that comfort is possible without (or with the minimum) use of energy. Approaches such as the use of renewable energy sources (wind, sun) and passive strategies (night cooling, solar collectors) will reduce the reliance on fossil energy sources hence resulting in a low CO_2 production.

The teaching of bioclimatic architecture in schools of architecture and making its principles available to working professionals is therefore an important consideration. Although there is a body of expertise in climatic architecture in the Indian subcontinent, the teaching of architecture in all countries, both developed and developing, tends to put a low value on climatic design.

The objective of this project was to make available the best information about low energy buildings and daylight prediction to students and professionals in the Indian subcontinent, as well as in Europe, through the use of IT-based teaching methods. The web package is designed to be highly accessible to the target audience of students and building professionals in India and neighbouring countries. The information contained embodies the best knowledge available from both Europe and Asia.

2. BACKGROUND

A few years ago, two web-based multimedia teaching packages, *DayMedia* and *MulCom* were developed by LEARN in collaboration with a number of European academic and industrial partners. They were both aimed at students and building professionals. The packages explain the principals of low energy building techniques and natural lighting of buildings. The projects were part-funded by the European Commission's *SAVE* and *Leonardo* programmes. The advice given in those packages is largely applicable to European conditions.

A new project under the *Get-in-touch and*

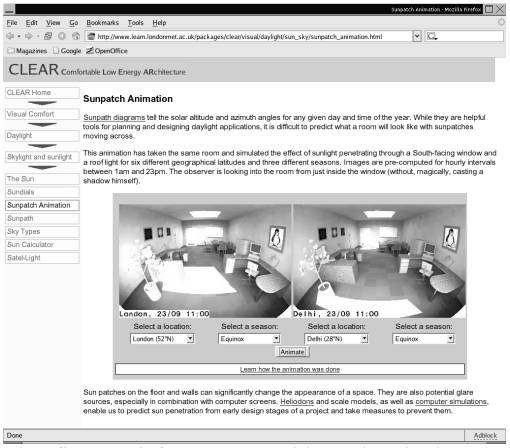
keep-in-touch component of the Commission's *Asia IT&C* [5] programme was funded in order to make the packages suitable for use by students and professionals in other parts of the world, namely the Indian sub-continent. The partners in the project are LEARN (co-ordination), School of Planning and Architecture, TVB School of Habitat Studies (both in Delhi, India), and the National Kapodestrian University of Athens, Greece.

The main tasks in the project were to amend the two existing multimedia packages for the climates of the Indian subcontinent, to revise the contents and to improve upon the layout of the pages. The project included rigorous evaluation of the packages both, in regard to their content and their usability by the target groups.

3. WEB-BASED COLLABORATION

Most readers would agree that a collaboration between partners in different European countries can oftentimes be difficult. Face-to-face meetings are in our experience the most productive form of communication. However, travelling in person is expensive and rarely done except for the scheduled meetings, and most exchanges of ideas is now done via e-mail. Within Europe, it is also easy to have telephone conversations or even to send old-fashioned post.

Having partners in India, however, created a whole new set of issues that had to be dealt with. With an IT infrastructure that is hardly coping with the demand and is not even available to all institutions yet, it very often took a day or two before the reply to an e-mail came back. Part of the problem is certainly the time shift of 4.5 or 5.5 hours. This also made it difficult to have telephone conversations with the Indian partners. Letters are very slow, expensive, and unreliable.



The first and foremost problem that had to be resolved was to allow all partners to work on the project without having to send all content to London (or Delhi) and wasting valuable time and resources waiting for somebody to put them up on the site.

The solution was for LEARN to develop a special Content Management System, CMS. The clearly defined structure of the web site, as well as the detailed technical brief and design guidelines laid out by the co-ordinator based on their previous experiences with web-based packages and remote collaboration meant that the partners could work relatively independently from one another. A password-protected upload area on the staging server allowed for the upload of contents directly into the partner's branch of the *CLEAR* tree. The CMS made the production of the site very efficient and proved invaluable in the integration of the various pages, images and interactive contents.

Another interesting issue which the partners in India brought to our attention is that one of their requirements is for the package to be as small as possible. Many Internet users on the subcontinent are still on slow dial-up modem connections. Broadband or better connections are not readily available or prohibitively expensive. While it is good practice for any web designer to consider users on slow connections, it has unfortunately become all-too common to bloat up pages unnecessarily with banner images, Flash animations, background images and other high users of bandwidth. *CLEAR* doesn't have any of those. Instead, a clean and lean approach was consequently followed which hope-

fully will make our users on slow connections as happy as it does the ones that enjoy the luxury of fast broadband.

4. CONTENTS

CLEAR consists of three parts which are outlined below:

I) Thermal Comfort and Building Performance
   a) People
   b) Climate
   c) Buildings
II) Visual Comfort and Daylighting
   a) People
   b) Daylight
   c) Buildings
III) Interactive
   a) Performance Analyser
   b) Design Matrix

Part I) is based on the former *MulCom* package, while II) is derived from *DayMedia*. The Design Matrix, III.b) is new and is one of the most interesting features of the package.

Bioclimatic design involves considering climate as a parameter of design in every aspect of the building and built environment. The Design Matrix puts forth these various aspects in a logical sequence, effectively dissecting the design into its constituent elements that can be acted upon. The sequence proceeds from a macro level to micro level details.

Contexts A which is missing from the table, is the ecological and physical context which is what 'normal' building design is usually concerned with and is without consideration of bioclimatic issues.

If it turns out that even with the help of the design matrix some of the human comfort criteria can not be met, plan F needs to be considered which covers active strategies and interventions. The design of a bioclimatic building that has minimal impact on the environment yet at the same time provides comfortable conditions for the inhabitants is not always possible to achieve. This is especially true for climates that have two or more extremes with contradicting parameters. In moderate climates, for instance, buildings will typically get too hot in summer, while habitation during the winter months is not possible without additional heating.

The sub-levels of contexts B to E are listed in the table below.

Context	Level	Design Sequence
B: Settlement Pattern and Site Planning	1, 2	Landform, Land-
	3	Vegetation type
	4	Water bodies
	5	Street widths and
	6	Open spaces and
	7	Ground character
C: Passive Heating and Cooling Design Strategies	8	Plan form
	9	Plan elements
	10	Building orienta-
	11	Surface area to
	12	Roof form
D: Openings, Daylighting and Natural Ventilation	13	Fenestration pat-
	14	Fenestration con-
	15	Fenestration ori-
	16	Fenestration controls
	17	Roof materials
E: Building Envelope	18	Walls
	19	External colours
	20	Internal materials
	21	Internal finishes

As an example, Level 13 of the Design Matrix is shown which deals with fenestration patters. On the actual web page, all cells are active and lead when selected to additional information of the relevant topic, including theory, design implications and guidelines (see Appendix 1).

5. RESULTS

The *CLEAR* web site was moved from the development server to its final destination in December 2004. The most objective judgement of its acceptance is to take a look at the statistics from the web server.

	No. Visits per Month	Pages Viewed per Month	Bandwidth per Month	Bandwidth / Page	Notes
DayMedia	581	1861	270 MB	149 kB	1
MulCom	378	2847	361 MB	130 kB	1, 3
CLEAR	2996	11712	561 MB	49 kB	2

1) Figures are monthly averages over the period of May to

December 2004.

2) Figures are for January 2005.

3) Since MulCom makes use of frames for the navigation, for every page of content, a total of three pages are requested from the server: the frame, the navigation bar, and the actual contents. To get accurate results, the figure for bandwidth per page would have to be multiplied by three, while the actual number of pages viewed is only a third of what is indicated.

The web stats show that *CLEAR* has already succeeded both its parent packages in popularity on the web. We like to attribute this to the much cleaner implementation and faster speed of *CLEAR*. It is also apparent that the design brief to keep the page sizes slow was met. The average download size per per is significantly smaller than with *MulCom* and even *DayMedia*.

6. CONCLUSIONS

The EU *CLEAR* project is the first teaching/documentation project that the authors are aware of which updates and improves an existing teaching package which was published under a Free Software License. This approach is well-established and has been proven to be far superior compared to the traditional licensing models for software. *CLEAR* has shown that given the right license, a similar approach may be taken towards the development of documentation and other packages which are not software. By explicitly allowing and encouraging others to not only use what's there and to distribute it free of charge, but to further and improve it as well, it is hoped that the tremendously successful Open Source/Free Software licensing model will be taken up by others, especially in the academic sector, resulting in a lot of high-quality teaching notes, tutorials and other documentation to form the knowledge base of tomorrow's experts.

CLEAR has made this first step in the field of low energy architecture and human comfort. Will others follow?

ACKNOWLEDGEMENTS

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[6] GNU: http://www.gnu.org
[7] GNU FDL: http://www.gnu.org/licenses/fdl.html

APPENDIX 1

Context	Level	Params	Cold			Moderate	Hot	
D	13	AIR TEMP. RADIATION R.H. AIR FLOW DAYLIGHT FENESTRATION PATTERN